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ABSTRACT

Research tested an anxiety reduction technique in a computer-based learning situation. Computer-based situations were used because they permitted controlled studies using materials relevant to the real-life needs of students and allowed repeated measurements of state anxiety in response to learning materials. Thus, the relationships between anxiety reduction and subsequent state anxiety and that between state anxiety and performance could be uncovered. The State-Trait Anxiety Inventory was used, following several tests of its reliability and validity. Since previous studies did not directly measure state anxiety, but rather inferred it from behavioral or performance indexes, a new paradigm was developed to study the mutual effects of state anxiety, cognitive abilities, and experimental treatments on a concept learning task. An experimental group received memory support when requested; two control groups received it, respectively, continuously, or never. Results from the MA-3 Associative Memory Test showed that the experimental group required fewer trials to criterion and had lower levels of anxiety. Thus, directly measured evidence was offered for the contention that the anxiety reduction treatment of memory support reduced state anxiety. (PB)

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Anxiety Reduction and Computer-Assisted Learning¹

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Although it has been recognized that anxiety can interfere with the learning process (Sarason, 1960, Spielberger 1966), relatively little research has been concerned with reducing anxiety per se in the learning situation. This scarcity of research in the area of anxiety reduction may be attributed largely to the theoretical and methodological confusion regarding the construct of anxiety and how it should be measured. A number of researchers have found it useful (following Spielberger, 1971) to differentiate conceptually between anxiety as a transitory state and as a relatively permanent trait.

According to Spielberger (1966, pp. 16-17), 'anxiety states (A-State) are characterized by subjective, consciously perceived feelings of apprehension and tension accompanied by or associated with activation or arousal of the autonomic nervous system. Anxiety as a personality trait (A-Trait) would seem to imply a motive or acquired behavioral disposition that predisposes an individual to perceive a wide range of objectively non-dangerous circumstances as threatening, and to respond to these with A-State reactions disproportionate in intensity to the magnitude of the objective danger.

The State-Trait Anxiety Inventory (Spielberger, Gorsuch & Lushene, 1970) was developed to measure both anxiety as a transitory state and as a relatively permanent trait. Since this paper will report the results of an anxiety

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reduction technique on state anxiety in a computer-based learning situation, the rationale for investigating state anxiety in a computer-based learning situation will be presented first, followed by a discussion of the reliability and validity of the state anxiety scale of the State-Trait Anxiety Inventory. Finally, the findings themselves will be briefly reviewed.

Computer-based learning situations were chosen as the basis for this research, since in this context the investigation of learning may be carried out under relatively controlled conditions, with materials that are more relevant to the real-life needs of the students than are typically used in traditional laboratory tasks. In a computer-based learning situation one may repeatedly measure the students' state anxiety in response to meaningful learning materials. Thus, repeated measurement of states of anxiety as learning progresses could enable investigators to determine in finer detail the nature of the relationship between anxiety reduction and subsequent state anxiety as well as the relationship between state anxiety and performance. Following a specification of these relationships, the researcher could program the computer so as to minimize anxiety and to maximize performance. These capacities in a computer-based learning approach help to bridge the gap between laboratory research on anxiety in learning and applications of learning principles in the classroom.

The reliability and validity data to be reported were collected using the short form of the A-State scale of the State-Trait Anxiety Inventory. The short form consists of five items² chosen on the basis of

²These items were (a) I am tense (b) I feel at ease (c) "I am relaxed" (d) "I feel calm" (e) "I am jittery." The subject responded to each item by rating himself on the following four-point scale (a) Not at all; (b) "Somewhat" (c) "Moderately so;" (d) "Very much so."

their high item-remainder correlations with the total scale. The items for this scale were presented one at a time on a cathode ray tube terminal (TV-like video display with typewriter-like keyboard) of the IBM 1500 instructional system.

Leherissey, O'Neil, and Hansen (1971) reported alpha reliability coefficients for five state anxiety scales in a computer-assisted learning task of .87, .83, .87, .86, and .93. O'Neil (in press) reported alpha reliabilities for the three five-item A-State scales given during a CAI learning task of .86, .88, and .89. Leherissey, O'Neil, and Hansen (in press) report alpha reliabilities of .87, .89, and .92 for the three short-form scales given during a CAI learning task. Hedl (1971) reported alpha reliabilities of .91 and .92 before and after a computer-based intelligence test. Further research by Hedl (SIT-0) using the computer-based intelligence test found alpha reliabilities of .87 and .89. In a third study by Hedl (SIT-1) alpha reliabilities of .83 and .93 were reported for A-State scales before and after, respectively, a computer-based intelligence test. In summary, reported alpha reliabilities have ranged from .83 to .93 in seventeen comparisons. Therefore these values indicate that the five-item state anxiety scale has high internal consistency.

Evidence of construct validity for this scale has been provided by four studies (O'Neil, Spielberger, & Hansen, 1969; Spielberger, O'Neil, & Hansen, in press; Leherissey, O'Neil, & Hansen, 1971; Leherissey, O'Neil, & Hansen, in press). In all of these studies state anxiety varied as a function of task difficulty, i.e., higher state anxiety during more difficult materials. In addition high levels of state anxiety were debilitating to performance. Further evidence for the reliability and validity of the A-State scale can be found in the manual for the State-Trait Anxiety Inventory (Spielberger, Gorsuch, & Lushene, 1970).

Thus there is the suggested evidence that the five-item form of the state anxiety scale of the State-Trait Anxiety Inventory is both reliable and valid. Such evidence indicates that the scale can be of use in determining differences in levels of state anxiety in experimental situations. Therefore the effects of treatments on state anxiety may be determined using this scale.

An important implication of the above mentioned conceptual and methodological distinctions for research on anxiety reduction is that one can actually measure whether anxiety has been in fact reduced rather than only inferring this reduction on the basis of improved performance. However most of the research studies which have been concerned with experimental treatments which reduced the disruptive effects of anxiety and performance have not measured state anxiety. Rather they have used a behavioral or performance index for which anxiety reduction was inferred. For example this rationale was used in a promising line of research by Dr. Joan Sieber Suppes and her colleagues.

In Sieber's (1969) paradigm, following a task analysis of the learning materials, a logical argument is made that particular cognitive processes are related to performance in that task, e.g., that use of memory processes is necessary for good performance in concept learning. If high anxiety is disruptive to functioning of the cognitive process, it is argued that this effect is one cause of poor overall performance. Experimental manipulations (such as memory support) which reduce the debilitating effects of anxiety on functioning of the cognitive processes and thus on overall performance are interpreted to have improved overall performance by either a reduction of the level of anxiety and/or by alteration of the task such that performance requirements were more congruent with the abilities of high anxious subjects. In her paradigm the exact causal relationships cannot be directly determined.

Leherissey, O'Neil, and Hansen (1971) attempted to investigate the causal relationships directly by using memory support and measuring its impact on state anxiety. Then the joint impact of state anxiety and memory support on performance was investigated.

Leherissey et al. (1971) used the same mathematics materials used in prior research in our laboratory (O'Neil, Spielberger, & Hansen, 1969 O'Neil, Hansen, & Spielberger 1969), but supplied a list of previous errors committed as a memory support to the experimental group. No memory support was supplied to the control group. The short form of the state anxiety scale was administered at intervals during the experiments. An interesting result in this research was that state anxiety in the memory support group was higher, although not significantly higher, than state anxiety in the no memory support group. It is possible that the reminder of errors committed was anxiety producing (Leherissey, et al. 1971).

Moreover, a significant state anxiety $\times$ treatment interaction was found ($p < .05$). No memory support subjects who were high in state anxiety made many more errors than did subjects with low and medium levels of state anxiety. High state anxious subjects in the memory support condition made fewer errors than did the high state anxious, no memory support subjects, but still more errors than the low and medium state anxious, memory support group. Implications drawn from the results were that provision of memory support facilitates performance of high state anxious subjects.

While demonstrating the usefulness of the five-item state anxiety measure Leherissey, et al. (1971) ignored the effects of the experimental manipulation on the cognitive processes involved in performance on the learning task. Since the provision of memory support did not improve performance on the

learning task by reducing the state anxiety level of the subjects, it seems that the effects of the memory support must have altered the task in such a manner as to reduce the disruptive effects of anxiety and performance. The exact relationships of the cognitive processes to performance cannot be determined from the results of the study, as there is no specification of the information-processing abilities required for performance on the task, nor was there a measure of the ability in question (memory).

In summary, Sieber (1969) has indicated that the debilitating effects of anxiety on the functioning of cognitive processes can be reduced through experimental manipulations of the task. However, the specific causes of the improvement in performance are not determined in her paradigm. Leherissey *et al.* (1971) demonstrated the usefulness of state anxiety measures in determining the effects of experimental manipulations on the anxiety level of the subjects. State anxiety was used successfully as a predictor of performance.

Both the approach of Sieber and Leherissey *et al.* ignore the measurement of the cognitive processing abilities of the subjects. A paradigm for studying the mutual effects of state anxiety, cognitive process abilities, and experimental treatments on performance on a concept learning task has been argued in a study by Collier, Poynor, O'Neil, and Judd (1972).

Collier *et al.* (1972) investigated whether allowing a student to use memory support or not, at his discretion (i.e., learner control) on a multi-category conjunctive concept learning task would result in improved performance and/or reduced A-State. According to Hansen (1971), this manipulation may affect A-State in the following way: If one allows the student some measure of control over the learning situation, he may reduce at least some of the perceived situational threat. In the learner control situation the student has some

measure of control over the source of the perceived threat. If he perceives the memory support as a threat he can eliminate the threat by not using the learner control option.

Following an information processing analysis of the task, the use of memory support (the past two positive instances) was selected as a learner control option. Two control groups were used. One group always received memory support (memory support group), while the second never received the support (no memory support group). The memory measure was the MA-3 Associative Memory Test from the French Kit of Reference Tests (French, Ekstrom, & Price, 1963). Unfortunately, linear regression analysis indicated that associative memory ability was unrelated to performance on the task. However the three groups differed significantly in trials to criterion [No Memory Support ($\bar{X} = 77.8$), Memory Support ($\bar{X} = 51.4$), and Learner Control (41.1)]. Of interest to us, the learner control group showed significantly lower levels of state anxiety ($\bar{X} = 8.3$) than either the memory support ($\bar{X} = 10.4$) or no memory support ($\bar{X} = 10.6$) groups.

Thus some support is offered for the contention that memory support in the study was actually reducing state anxiety and hence improving performance. In contrast, Leherissey *et al.* (1971) found that memory support did not reduce A-State. However the operations which defined memory support differed in the two studies. Leherissey *et al.* provide a list of prior incorrect answers as memory support, whereas Collier *et al.* provided two prior correct instances as their memory support. Thus, not surprisingly, the impact of memory support of state anxiety per se would seem to be a function of the operationalization of memory support. However, without the state anxiety measure one would not know whether state anxiety was in fact reduced.

In summary, I feel that state anxiety offers much promise as a dependent variable, as one can measure the impact of anxiety reduction treatments on state anxiety per se instead of inferring such effects.

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